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ABSTRACT

This report is intended to identify opportunities for rebuilding the South's economy on the foundations of technology and innovation; to describe some of the conditions in the region that affect the creation, transfer, and commercialization of technology; and to present specific recommendations to help the South make more effective use of its technological resources for economic growth. Introductory materials include a statement of the Southern Growth Policies Board (SGPB); listings of SGPB 1985-86 leaders and the 1986 Commission on the Future of the South committees, chairman, and members; the charge to the board for establishing the 1986 Commission on the Future of the South; and a summary of the commission's activities. Next, an introductory discussion considers opportunities and challenges, state policies, barriers to embracing technology as a growth system, and the impacts of technology and innovation. Seventeen graphs illustrate the status of technology in the southern region. Finally, findings and recommendations are presented for the areas of education and training; targeting resources to create centers of excellence; cooperation among employers, employees, universities, and government; global competition and automation; and long-term commitment to competitive excellence. Appendices include listings of speakers at committee hearings, sustainers of the Fund for the Future of the South, and SGPB staff members. (KM)

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1986 Commission on the Future of the South

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The Report of the Committee on Technology and Innovation

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Southern Growth Policies Board

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The Southern Growth Policies Board

The Southern Growth Policies Board is a public, interstate agency governed and supported by the state and local governments of the southern United States and Puerto Rico. It represents a regional commitment to excellence, a cooperative effort to develop, conserve, and put to best use the South's natural and human resources. In order to enhance the region's decision-making processes, the Board assembles objective information and makes recommendations regarding economic development opportunities in the South.

Board membership consists of five persons from each member state: the governor; a state senator and state representative appointed by the heads of their respective legislative houses; and two leading citizens appointed by the governor. Members include Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Virginia, and the Commonwealth of Puerto Rico. Other states eligible to join are Delaware, Maryland, Missouri, Texas, and West Virginia. The territory of the Virgin Islands is also eligible.

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1986 COMMISSION ON THE FUTURE OF THE SOUTH
REPORT OF THE COMMITTEE ON TECHNOLOGY AND INNOVATION

SOUTHERN GROWTH POLICIES BOARD

The Honorable Bill Clinton
Governor of Arkansas
Chairman, Southern Growth Policies Board

The Honorable William F. Winter
Chairman, 1986 Commission on the Future of the South

Dr. Jesse L. White, Jr.
Executive Director, Southern Growth Policies Board

EDITOR'S NOTE:

This document represents the final report of the Committee on Technology and Innovation to the full Commission on the Future of the South. Therefore, the findings and recommendations in this report do not necessarily reflect those of either the full Commission or of the Southern Growth Policies Board.

Jesse L. White, Jr.
Executive Director
Southern Growth Policies Board

The 1986 Commission on the Future of the South

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Betsy Cochrane
Frederick Humphries
Charles Robb
Wilson Wyatt

SGPB Staff: John Hodges-Copple
Stuart Rosenfeld

Government Structure/Fiscal Capacity

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Members: George Busbee
Jon Mills
Charles Morgan
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Human Resource Development

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Josephine Ayers
Bettye Caldwell
James R. Moffett
Mike Sturdivant
James Ward

SGPB Staff: Susan Levy
Stuart Rosenfeld

The 1986 Commission on the Future of the South

Chairman: **The Honorable William F. Winter**, former governor of Mississippi, currently practices law in Jackson.

Members: **Dr. Robert L. Albright**, President, Johnson C. Smith University, Charlotte, North Carolina.
Ms. Josephine E. Ayers, President, Partnerships, Inc., Anniston, Alabama.
Mr. George L. Bragg, Chairman, CEO and President of Telex Computer Products, Inc., Tulsa, Oklahoma.
The Honorable George Busbee, former governor of Georgia, currently practices law in Atlanta.
Dr. Bettye Caldwell, Donaghey Distinguished Professor of Education, Center for Child Development and Education, University of Arkansas at Little Rock.
The Honorable Betsy L. Cochrane, Minority Leader of the N.C. House of Representatives, Advance, North Carolina.
Mr. J. Mac Holladay, Director, South Carolina Development Board, Columbia, South Carolina.
Dr. Frederick Humphries, President, Florida A&M University, Tallahassee, Florida.
The Honorable Jon Mills, Majority Leader and Speaker-Elect (1987-88), Florida House of Representatives, Tallahassee, Florida.
Mr. James R. Moffett, Chairman of the Board and CEO, Freeport-McMoRan, Inc., New Orleans, Louisiana.
Mr. Charles Morgan, CEO and Chairman of the Board, CCX Network, Inc., Conway, Arkansas.
The Honorable Charles Robb, former governor of Virginia, currently practices law in Washington, D.C.
Mr. Irby C. Simpkins, Jr., Publisher, THE NASHVILLE BANNER, Nashville, Tennessee.
The Honorable William B. Spong, Jr., former U.S. Senator from Virginia, currently a professor at the Law School at William and Mary.
Mr. Mike P. Sturdivant, President, Mike P. Sturdivant Plantation, Glendora, Mississippi.
Ms. Shella Tschinkel, Senior Vice President and Director of Research, Federal Reserve Bank of Atlanta.
Dr. James H. Ward, Dean and Professor of Social Work, University of Alabama, Tuscaloosa, Alabama.
The Honorable Wilson W. Wyatt, Sr., former lieutenant governor of Kentucky and mayor of Louisville, currently practices law in Louisville.
Ms. Harriet Zimmerman, National vice-chairwoman of United Jewish Appeal, Atlanta, Georgia.

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Charge to the Board in Establishing the 1986 Commission on the Future of the South

**Governor Bill Clinton, Arkansas
Chairman, Southern Growth Policies Board
(1985-86)**

The opportunity in 1986 to be a part of the Commission on the Future of the South is especially important to me, because my state will be 150 years old this year. For most of that 150 years we have been like much of the South: rural, poor, and proud...always seeking elusive dreams and wanting something we knew we deserved and never have quite been able to achieve.

As we take this unique opportunity to look at the future of our region moving toward the 21st Century, I think we should ask ourselves some very searching questions. Can the South at long last achieve a standard of living that is equal to or beyond that enjoyed by the rest of this country? Can we at long last have the range of educational and economic opportunities that our people certainly deserve and clearly need? Can we do it in every state, in rural as well as urban areas, for blacks as well as for whites? How can we maintain an almost laser-like concentration on the education reform issue for at least a decade?

I am optimistic. I believe that the kinds of economic and structural changes which have occurred may make it possible for us as a people to achieve for the very first time the economic status that the character and values and strength of our communities and our people merit. But, I am also mindful of the fact that our optimism may be founded more on faith than light, as it has so often been in the history of the South. I hope that this Commission report can be very specific in identifying the things that we have to do if we are going to answer those questions. And I hope it will be the kind of report that we can implement in the years ahead.

One thing is paramount. None of our states can ever be where we hope they will if we have an increasing percentage of people living below the poverty line and no constructive response to it. If we have learned anything in the South better than the rest of the country, it is that we are going up or down together as a people. Because of our history and because of the progress we have already made, we should take upon ourselves the commitment to prove that our country can achieve excellence with equity. I am absolutely convinced that it can be done and it ought to be done in the South, better than and before any other region.

And, finally, let me say that we should never forget why we are doing this. I go back to Hot Springs, Arkansas, twenty-three years ago, when as a boy of seventeen I happened to hear Dr. Martin Luther King, Jr. make his "I Have a Dream" speech on television. I will never forget one thing he said that now means more to me than anything else. He said that he hoped one day his four little children would be judged not by the color of their skin but by the content of their character. I would like to see the people who live in my state and in my region be judged by the content of their character, but it will never happen until every child, by dint of his or her effort, can get a decent education and a decent, nationally competitive set of economic opportunities. And that is why we ought to do our best to chart the future of the South in 1986.

Excerpted from Governor Bill Clinton's inaugural address as Chairman of the Southern Growth Policies Board, June 1985, Atlanta, Georgia.

The 1986 Commission on the Future of the South

The specific goal of the 1986 Commission on the Future of the South is to produce "a short, readable report to the people of the South which can be used by governors, legislators, and other leaders to mobilize support for those public policies and public-private partnerships which will increase the per capita income, reduce poverty, and reduce unemployment for Southerners by 1992."

*Arkansas Governor Bill Clinton
Chairman, Southern Growth Policies Board*

The interstate compact agreement which established the Southern Growth Policies Board in 1971 calls for the Board to prepare a Statement of Regional Objectives every six years. This Statement is intended to recommend strategies for approaching regional problems and may also identify projects deemed to be of regional significance. The process that has emerged for identifying these objectives has become known as the Commission on the Future of the South.

The first Commission convened in 1974 under Georgia Governor Jimmy Carter's chairmanship; the second in 1980 under South Carolina Governor Richard Riley's. This year's Chairman of the Board, Arkansas Governor Bill Clinton, followed their example in appointing a blue-ribbon panel of twenty southern leaders from the public sector, business world, and universities. Former Mississippi Governor William F. Winter was selected to serve as Chairman of the Commission.

The formidable task before the 1986 Commission has been to address the challenge set forth by Governor Clinton, cited above. In the words of Governor Winter, "the heart of the problem has been to find a solution to the dilemma of two Souths which are rapidly growing farther apart. One is represented by the popular image of the modern Sunbelt. But there remains that other South, largely rural, undereducated, underproductive, and underpaid that threatens to become a permanent shadow of distress."

The full Commission held its organizational meeting in Atlanta in January 1986. At its next meeting in March, Governor Winter appointed three working committees on topics identified as critical to the progress of the region: Human Resource Development; Technology and Innovation; and Government Structure and Fiscal Capacity. The committees decided to seek information about the region's problems and opportunities via public hearings across the South. During the spring, the committees held seven public hearings, taking testimony from 77 expert witnesses and receiving written testimony—including commissioned papers—from many others. Each committee distributed a synopsis of the information it accumulated and the issues it identified to all Commission members.

The full Commission assembled again in May in Atlanta to hear reports concerning five "cross-cutting themes" whose impact upon southern economic development would be considered in all Commission deliberations. These themes included concerns about equity, the internationalization of the southern economy, disparities in the economic progress of urban and rural areas, capital and infrastructure issues, and quality of life. Consultants prepared written reports about each of these cross-cutting issues. In addition, they contacted hundreds of individual Southerners and groups to gather information for their reports.

Upon the conclusion of the public hearings, each committee drafted a report which outlined its findings and recommendations. The three committee reports and five cross-cutting reports were presented at the fourth meeting of the full Commission in September at the Graylyn Conference Center in Winston-Salem, North Carolina. Through a series of lengthy roundtable discussions, the Commission crafted the ten strategic objectives which are presented in the final Commission report.

The final report of the 1986 Commission on the Future of the South was presented in November to the full Board of Directors of the Southern Growth Policies Board at its 14th Annual Meeting in Little Rock, Arkansas.

PREFACE

As the 1986 Commission on the Future of the South began its deliberations to recommend regional objectives for the next six years, it examined an increasingly important aspect of growth not addressed in depth by previous Commissions—technology and innovation. Six years ago the South still pinned its hopes for continued growth on its ability to produce goods at lower costs; today, in the face of increasing international and regional competition and accelerating technological changes, the region has to rely on its ability to be more creative and innovative. In response, the Commission on the Future of the South selected *Technology and Innovation* as one of three key topics around which it would structure its information and inquiries. A Committee on Technology and Innovation was formed and charged with determining what states might do, individually or together, to harness technology and innovation in ways that will spur economic progress.

The Committee and staff conducted two public forums in the spring, one in Atlanta, Georgia, and one in Columbia, South Carolina, to discuss technology and innovation issues with various experts. The academics, business leaders, government officials, economists, and researchers who gave testimony before the Committee are listed in Appendix A. Committee members and staff convened again in Alexandria, Virginia, to review that testimony and to develop specific recommendations. Additional meetings were held in conjunction with the meetings of the full Commission on the Future of the South.

Despite the diverse backgrounds and expertise of those who testified before the Committee, four recurrent themes were prominent:

- The South has become part of a highly competitive global economy.
- Rapid technological advances hold the promise of an economic renaissance if the South is willing to commit to excellence.
- To succeed, the South must equip its people with the skills and education to adapt to changing job requirements in a churning global economy.
- Southerners are becoming increasingly interdependent; prosperity for one group will require prosperity for all.

The report of the Committee is intended to identify opportunities for re-building the South's economy on the foundations of technology and innovation; to describe some of the conditions in the region that affect the creation, transfer, and commercialization of technology; and to present specific recommendations to help the South make more effective use of its technological resources for economic growth.

INTRODUCTION

A technological renaissance is reshaping the cultural and economic landscape of the world. Technology is changing the structure of the world's communities and industries, changing how people earn their living and live their lives, shrinking the globe, and reshuffling the cards of economic power. Technology has overcome information and transportation barriers to allow the rapid, widespread movement of knowledge, goods, and people. It is having just as profound an impact on the South. The extent to which the South meets the challenges of this watershed period in economic development will determine whether the South flourishes or merely holds it own.

The result of these changes is a new and constantly evolving worldwide economy that is continually redirected by the latest shifts in the region's competitive posture. Competition is no longer just the company in the next county or state; it is also the company halfway around the world, which may be supported by a highly efficient local infrastructure. Global competition is keener than ever before in history.

Whether the South will succeed in the new world economy or relegate itself to subordinate status will depend on how well it is able to adopt a global perspective and adapt to continual technological change—whether the South is willing to commit to excellence.

The situation is urgent: manufacturing, the bread-and-butter sector of past southern growth, is declining. It is now about one-fifth of nonagricultural employment and is expected to continue to fall. Although there are many reasons for the decline, a large factor has been the growing competitiveness of industries in other countries, spurred by increased use of advanced technology in design and production. Corporations in other countries have made sizable investments in new processes and created government, business, and educational alliances to develop long-range, competitive, international postures.

What is this "technology" that is so changing the world around us? Technology can be viewed as the application of knowledge to develop new products and services, better processes, and more effective management. New technology can be as simple as the introduction of the shopping cart, which helped change the grocery-buying habits of the country, or as complex as the latest microelectronic devices. Technological advances, the engine of growth of the economy, account for upwards of one-half of the growth in the Gross National Product. Moreover, ripple effects spread the benefits to many more industries than the one that first uses a new technology, multiplying the return to the economy.

Whenever "technology" is discussed, "innovation" must also be discussed. If technology is the core of knowledge that can be applied, then innovation seizes the opportunity to actually use the knowledge. One without the other is of little value. Policies and programs that ignore the difference between building a technology base and developing an innovative mind set will miss important opportunities.

It is the rate at which new technology is applied through innovation that determines where the global economic pie will expand, and which regions will gain or lose from the changing environment. The South may become less competitive in many industries unless major shifts in priorities are undertaken in the very near future. How aggressively the region "harvests" innovations and how carefully it "harnesses" technology will be key factors in the economic future of the South and its people.

Opportunities and Challenges

Technological change is a two-edged sword and thus brings new challenges along with opportunities. Technology can eliminate drudgery in work or physical labor itself, but it leads to increased competition from abroad for markets and products. It improves health and cures disease, but places new stresses on the environment. Technology offers new opportunities for education, but requires many workers to master new and more complex skills. Technology increases productivity and creates new jobs, but can displace some people from their occupations and livelihood, particularly in rural areas.

Occupational displacement, perhaps the most visible downside of technological change, can be addressed by retraining and outplacement programs, but it requires a high level of cooperation between industry and public institutions. The problem is unlikely to be resolved by discouraging

the introduction of new technology; lessened competitiveness may lead to a firm's demise, displacing more workers than would a new technology. Displacement is particularly difficult where those involved have limited education or employable skills, or where they live in rural areas with few job alternatives. Unusual sensitivity to the challenges of long-term training and mobility needs must be a major part of any public agenda.

There are many positive actions that can be taken to encourage innovation and technological development in the South. At the same time, there are many positive actions that can be undertaken to soften the negative impacts of change on those directly affected. However, the time to act is now; with or without the South, the technological renaissance is rapidly changing the world. Southerners can either experience positively orchestrated social change, or can witness an ever-deteriorating social, economic, and physical environment.

State Policies

Before the 1980s there were few state policies outside of agriculture that directly addressed technology and innovation. The assumption was that technology and innovation are forces over which state and local governments have little control, that, like "creativity," they are amorphous ingredients of growth. Raw materials, labor, and capital were the traditional and concrete components, which governments could understand and influence. The attitude of most state governments was that technology just happened, mostly as a result of academics seeking knowledge with federal money, corporate researchers seeking new business opportunities, or as a by-product of military and space programs. State governments were expected to react, not act.

Today state leaders are beginning to take a different view of technology policy. States are undertaking new initiatives hoping to discover the combination that brings jobs and higher income. The goals of most state programs and policies are to (a) spur the creation of new technologies, (b) improve the transfer of those technologies into commercial applications, (c) balance the benefits between urban and rural, poor and wealthy areas, or (d) share the risks of new ventures that have high social value to the state by providing seed and venture capital and business start-up assistance.

Barriers to Embracing Technology as a Growth Strategy

Even with the rise in the status of technology in states' portfolios of growth strategies, there is resistance to public investment and involvement. Innovation entails risks and portends change. Sometimes, those changes are threatening because of how they affect existing ways of life. The air conditioner, for example, radically altered the South's economy. Even though it has brought new jobs and prosperity to many parts of the South, it also has brought new people and new lifestyles.

First and most important, many policymakers are not as comfortable with technology as a source of new jobs as they are with traditional recruitment, where the methods and outcomes are clearer and more easily measured. Resistance to change brought about by lack of understanding may be the principal barrier to state involvement in technological development. Public officials are hesitant to invest in what they do not understand. Technology-based development must be demystified before it can be embraced.

"High tech" is often perceived—erroneously—as a separate industry, like microelectronics or biotechnology. Actually, it is now an essential part of almost all industries. Increasingly, it pervades our entire economy. Even traditional "smoke-stack" industries must automate and incorporate innovative technologies in order to remain competitive. Technology is essential to the maintenance and expansion of almost all existing industry, big and small. It is not something separate and apart. Consequently, the South must keep pace with technological change in order to serve existing industry and seek new opportunities.

Many state policy makers, along with society as a whole, are not technologically literate. Most feel more comfortable with the technology of one's youth, rather than the technology of the late 1980s. For many, there is an air of profound mystery surrounding the workings of a microcomputer and the idea of splitting a gene. The impact of this scientific illiteracy on policy decisions can be profound, because when decisionmakers are forced to deal with mystery rather than knowledge they tend to be hesitant. People would rather do nothing than take a chance ... and maybe be

wrong. The need for a working knowledge of technology, or the acknowledgement that public understanding of technological issues must be augmented by expert counsel, should be very high on any public agenda.

Second, public costs for encouraging new technologies can be large and the benefits uncertain. North Carolina has already invested more than \$80 million in its Microelectronics Center, and Texas invested tens of millions in its Microelectronics and Computer Center. These centers represent only a small fraction of the investment made by private industry in these important new areas of development.

Third, the time to economic fruition can be long. It took eleven years from the discovery of nylon to its first commercial application. Even though numerically controlled machine tools were developed in the late 1940s, by 1968 only one out of 200 machine tools was numerically controlled. By 1983 the figure was still only one out of 20. Technology-based strategies require patience.

Fourth, with accelerating rates of technological change, there are greater risks of failure or obsolescence. As quickly as one level of technology enters the market, the next generation is on the drawing boards. It took about 30 years to develop the transistor, five for integrated circuits, and only three for the microprocessor. Any investment in new technology involves risk. Even if initiatives are successful, the rapid pace of change may require continued reinvestment. While this risk is challenging for businesses working with specific technologies on a daily basis, it is extremely difficult for policy makers to cope with the changing environment. The meaning of "success" in the public sector must be carefully understood before public support can be garnered for specific programs.

Last, there is no guarantee that the eventual economic gains will remain within the boundaries of the state. States can form policies to retain royalties, but it is difficult to guarantee that the jobs created will stay within state borders.

As a result, public policy decisions about science and technology, with risks that are hard to measure and outcomes that are unclear, are quite difficult to make—and easy to postpone or avoid. But despite the costs and uncertainties, the long-term economic potential of technology is huge. Risks of omission (failing to invest) are higher than risks of commission (investing in technological development that does not yield results).

Choosing not to actively pursue technological development can relegate a state to an also-ran status. Support for and access to science and technology is an increasingly important factor in attracting investments, entrepreneurs, and productive people. Consequently, lack of such support inhibits technology-related growth and other forms of economic growth as well.

There is little choice in supporting technology; it is imperative. There are, however, choices to be made: which activities are most appropriate and consistent with the state's economy and its long-range development plans, and which activities promise the greatest public payoffs. Those regions, states, and communities that are willing to adopt new ideas, invest in new technologies, and adapt quickly to technological change have the opportunity to participate in the technology renaissance.

New England is a prime example of a region that was in distress not long ago, with manufacturing moving South and agriculture declining. The region now has the lowest unemployment rate and is among the fastest growing in the nation, with the largest proportion of its employment in technology-based industries. The South, with a vulnerable manufacturing base and declining agriculture, is now looking to innovative technologies to support a wide range of new manufacturing and service industries and to modernize its traditional manufacturing industries.

The Impacts of Technology and Innovation

The effects of technology and innovation are represented by new products and services, which lead to new businesses, expansions, and improved productivity and efficiency, new production processes, such as flexible manufacturing systems or food irradiation, and new management skills and methods, such as linear programming or Theory Z Management.

Some of the best examples of how public technology policy can contribute to growth are found in agriculture, where major government investments in highly centralized research activities and in the dissemination of that information to large numbers of small producers have paid off. Between

1965 and 1985, the number of cows producing milk decreased 25 percent but milk production increased 60 percent. New growth hormones (new products) on the horizon are expected to increase present yields up to 40 percent and computerized feed schedules (new processes) will improve yields another 5 percent.

The Reverend Thomas Malthus, in his wildest dreams, would not have predicted that agricultural productivity would grow as it has. Government support for agricultural research and development is the main source of the innovations that stimulated agricultural productivity. Thousands of publicly funded discoveries and innovations have resulted from the research at centralized, federally funded agricultural experiment stations and university-based cooperative extension programs. Today the nation has an agricultural system whereby three percent of the work force can produce more than enough food for an entire nation.

If public science and technology policy can be so effective for agriculture, what might it do for manufacturing or service industries? Traditional southern labor-intensive industries, which can no longer compete on the basis of costs of labor, can compete by substituting new manufacturing technologies for labor. Technology has the potential to revitalize even the most mature southern industries. The plant floor, however, may not look the same with new technology. At the Batesville Casket Company in Campbellsville, Kentucky, the only time a human is needed on the assembly line is to rewire or reprogram a robot. In South Carolina, claims agents of Blue Cross work at home on remote terminals, "telecommuting" to work.

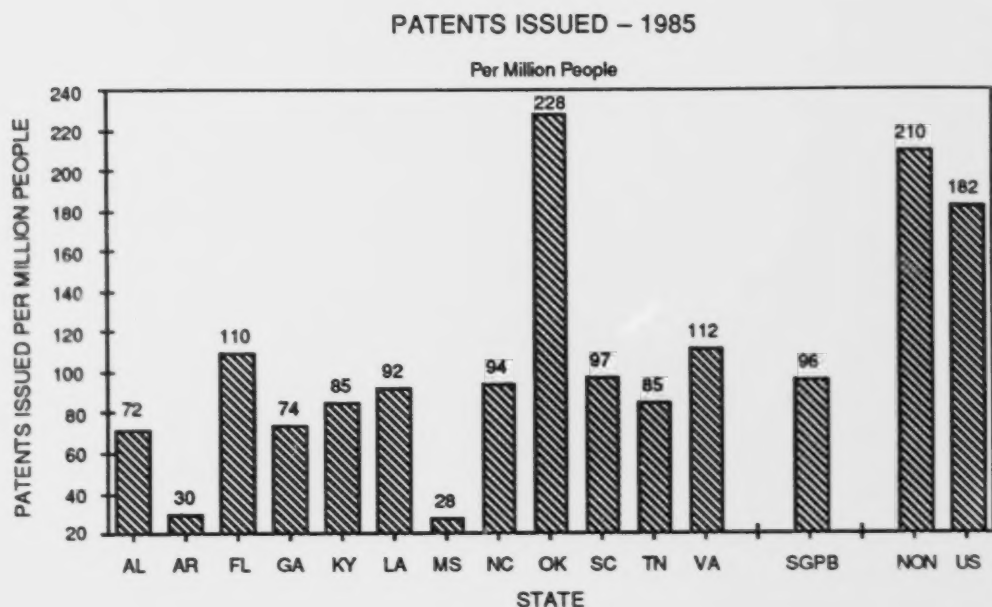
These new investments, which seemingly remove the human from the operation, create a whole host of new jobs to produce, service, and support the new technology. History teaches us that innovation generally produces far more jobs than it eliminates. The power loom in 19th century England, the telegraph in America, and the computer worldwide, which were all predicted to result in massive unemployment, actually spurred job growth.

There is, however, a disturbing human side to technological change. Those employed in the new factories or new offices may not be the same people who held the jobs in the past. The power loom created jobs in England's cities, but eliminated rural cottage industries. The new jobs often will not be in the same place as the old jobs, and even when they are, they are likely to require more complex or different skills, knowledge, and credentials than the previous workers had. The people of the South will need to be better educated and more adaptable. The average worker in the year 2000 is anticipated to change jobs seven times and occupations three times during his or her working life. Technological change is a powerful force for long-term growth and prosperity, but it brings short-term disruptions that must be addressed.

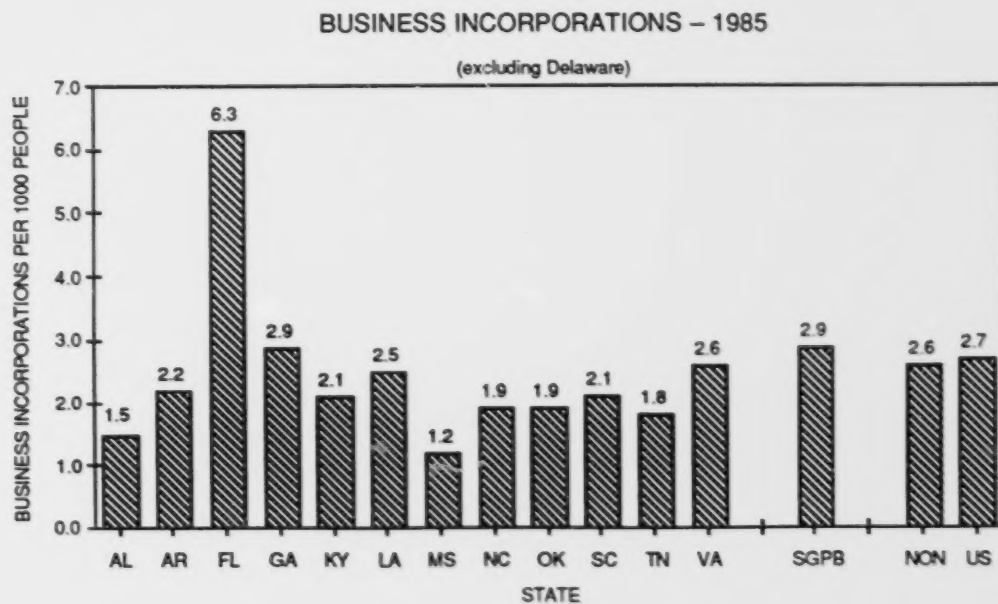
THE STATUS OF TECHNOLOGY IN THE REGION

Southern states already have developed initiatives to encourage technology-based development. Most initiatives, however, are relatively small in scale, are not widespread, and lack a long-term commitment. Despite the popular image of technological growth in the Sunbelt, many science and technology indicators portend future problems and, if not addressed, threaten the continued progress in the development and transfer of technology and innovation. Some indicators of the region's technological status are provided in this section.

A. Eleven of the twelve southern states trail the national average for patents issued per capita.

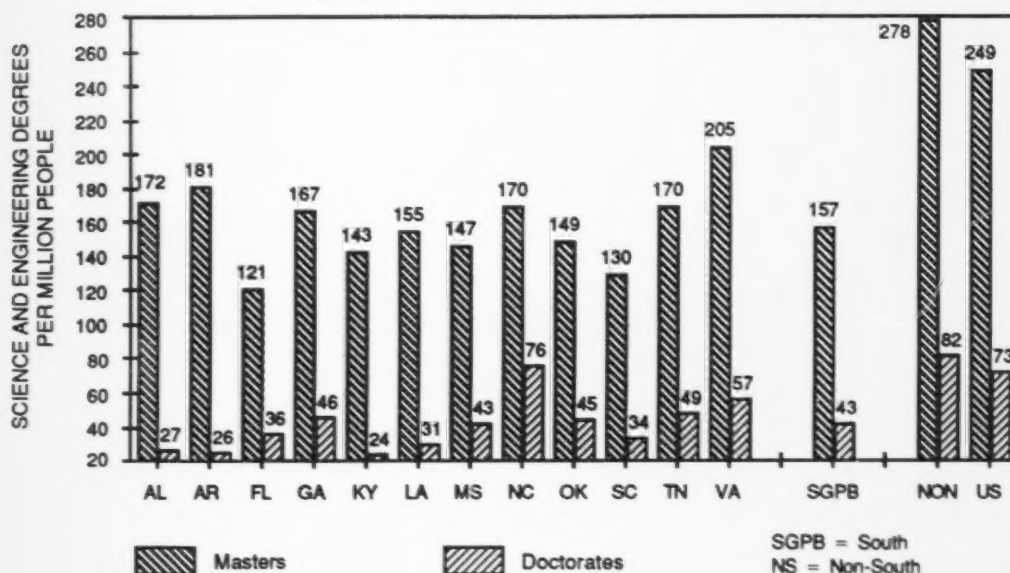


B. Ten of the twelve southern states trail the national average for business incorporations per capita.



- C. Southern universities awarded 16 masters degrees and 4 doctorates in science and engineering fields in 1982-83 for every 100,000 Southerners. Universities outside of the South awarded 28 masters degrees and 8 doctorates in science and engineering for every 100,000 non-Southerners.

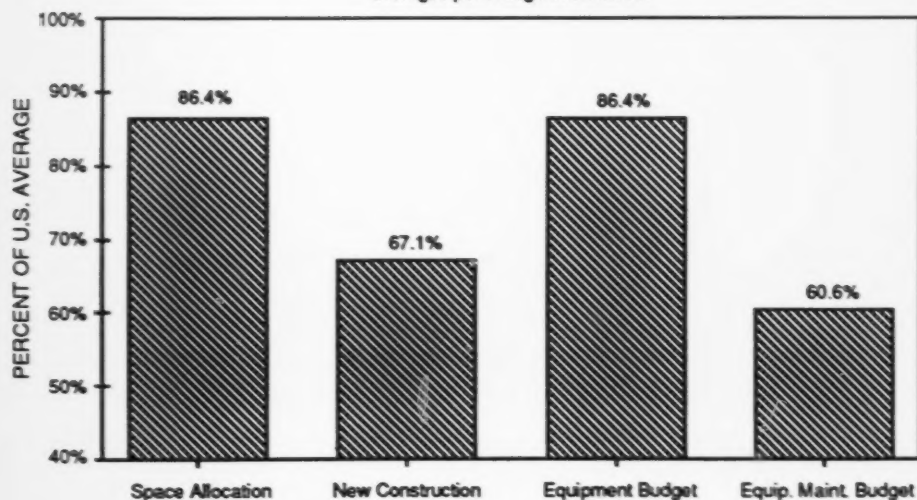
SCIENCE AND ENGINEERING DEGREES (82 - 83)



- D. Compared to colleges of engineering outside of the South, the average southern engineering school is smaller, growing at a slower rate, has an equipment budget proportional to its size, but an equipment maintenance budget that is proportionally smaller.

ENGINEERING SCHOOL BUDGETS AND SPACE

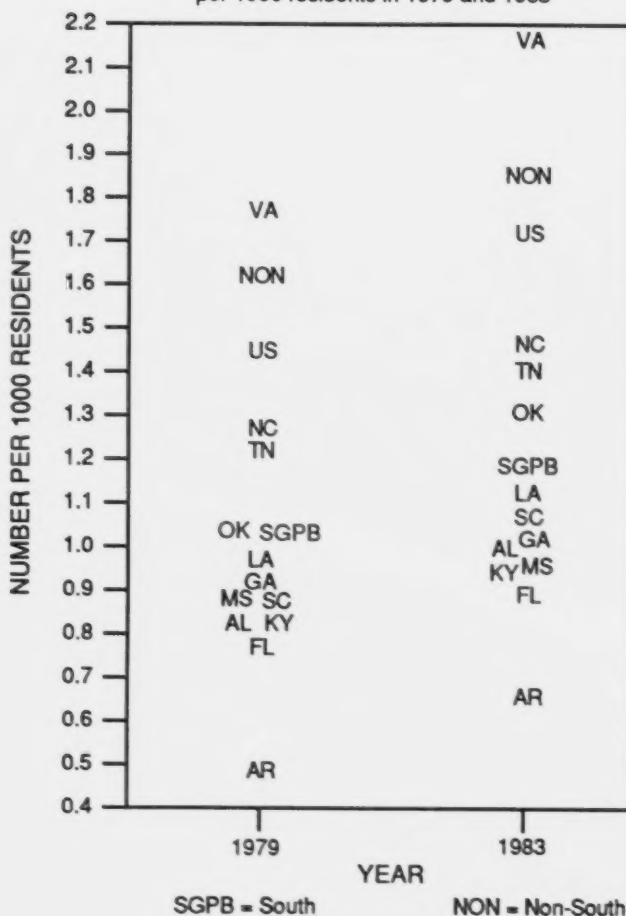
averages per college in the South



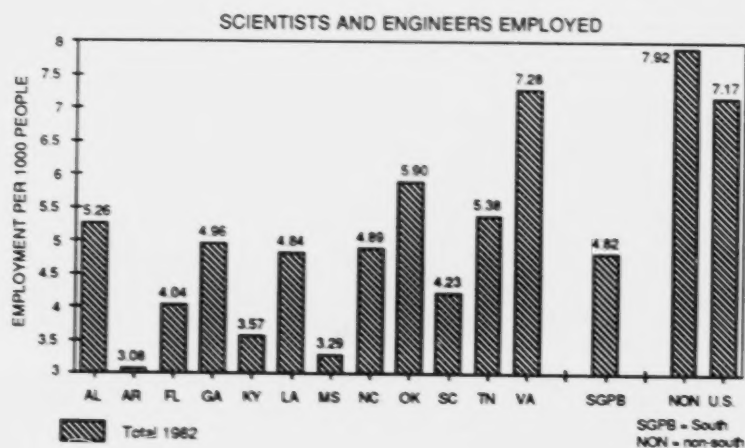
- E. There were fewer scientists and engineers in 11 of the 12 southern states in 1979 than the national per capita average; by 1983, the same 11 states still trailed the national per capita average. The South had a greater average percentage increase in scientists and engineers per capita than the non-South—15.3% versus 14.1%—but 6 of the 12 southern states had a percentage increase less than the national average.

PH.D. SCIENTISTS AND ENGINEERS

per 1000 residents in 1979 and 1983



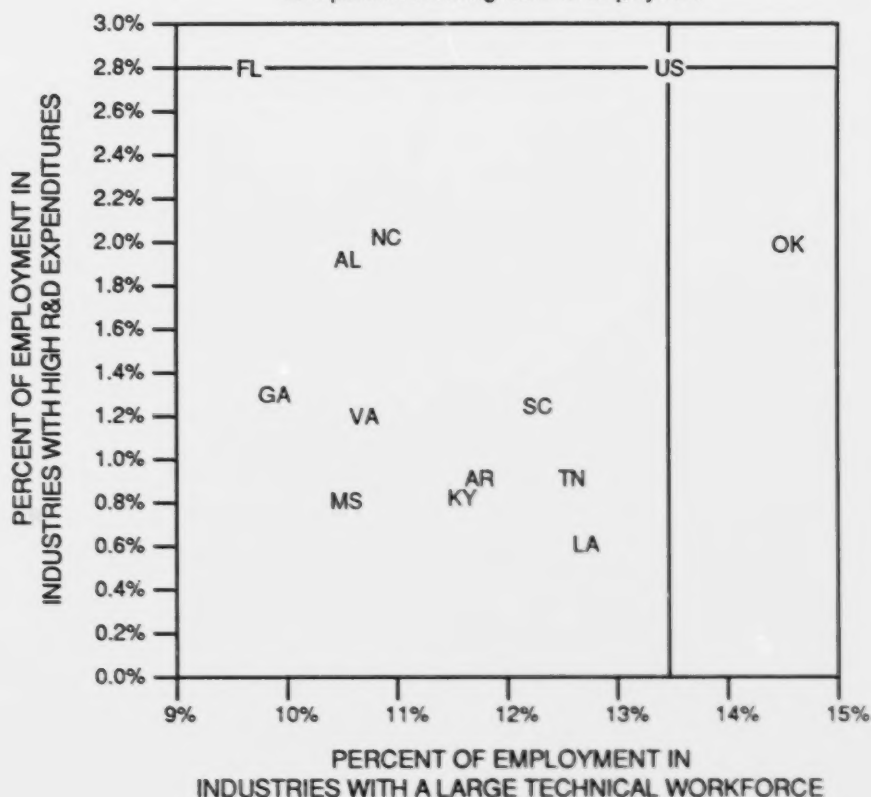
- F. In recent years, about 5 of every 1,000 Southerners were employed as scientists and engineers. About 8 of every 1,000 people outside of the South were employed as scientists or engineers.



- G. High technology industry is usually defined by either the proportion of the workforce in technical fields or the level of industry funding of R&D. High tech employment trails the national average in 11 of the 12 southern states when defined by the workforce, and in 11 of the 12 states when defined by R&D expenditures.

HIGH TECH EMPLOYMENT

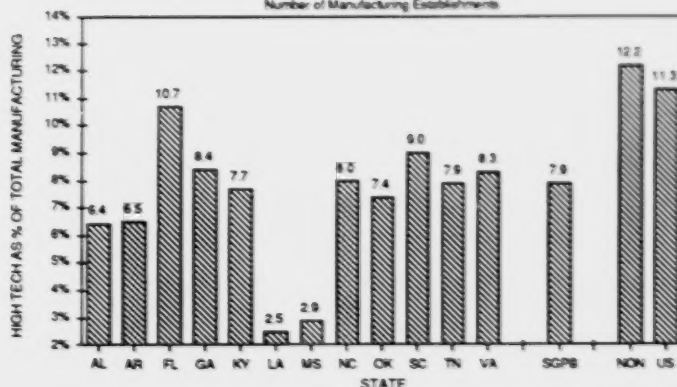
as a percent of nonagricultural employment



- H. At the time of the last Census of Manufactures, 8% of manufacturing establishments in the South were in high tech industries. Outside of the South, 12% of manufacturing establishments were in high tech industries.

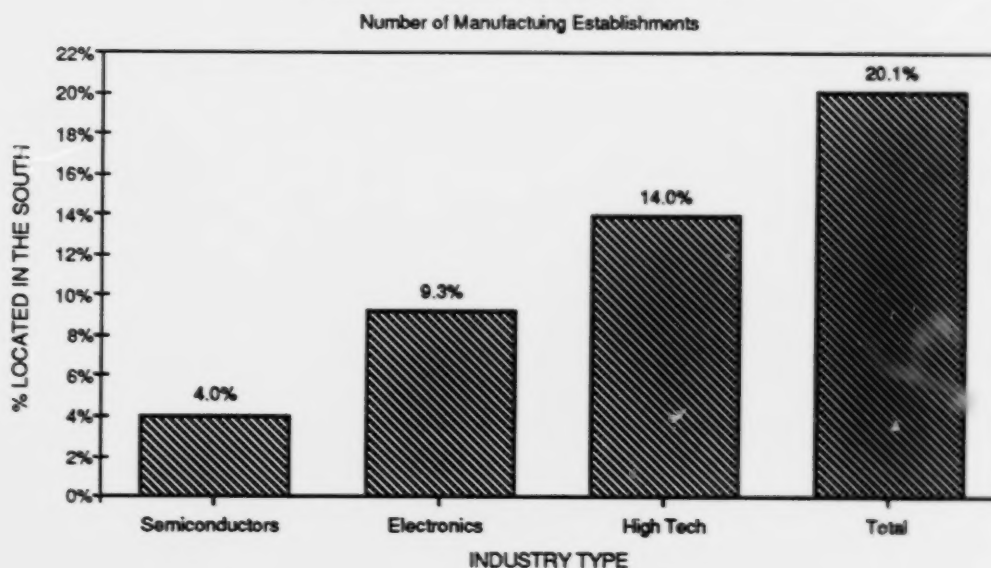
HIGH TECH MANUFACTURING - 1982

Number of Manufacturing Establishments



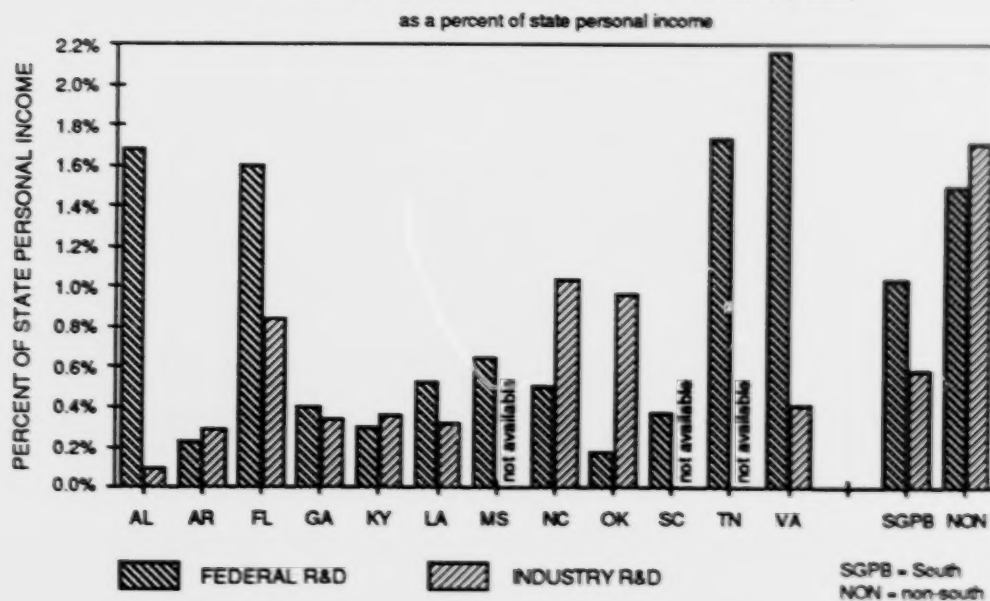
- I. Although 20% of the nation's manufacturing establishments are located in the South, only 14% of the nation's high tech manufacturing establishments are located in the South.

MANUFACTURING INDUSTRIES - 1982

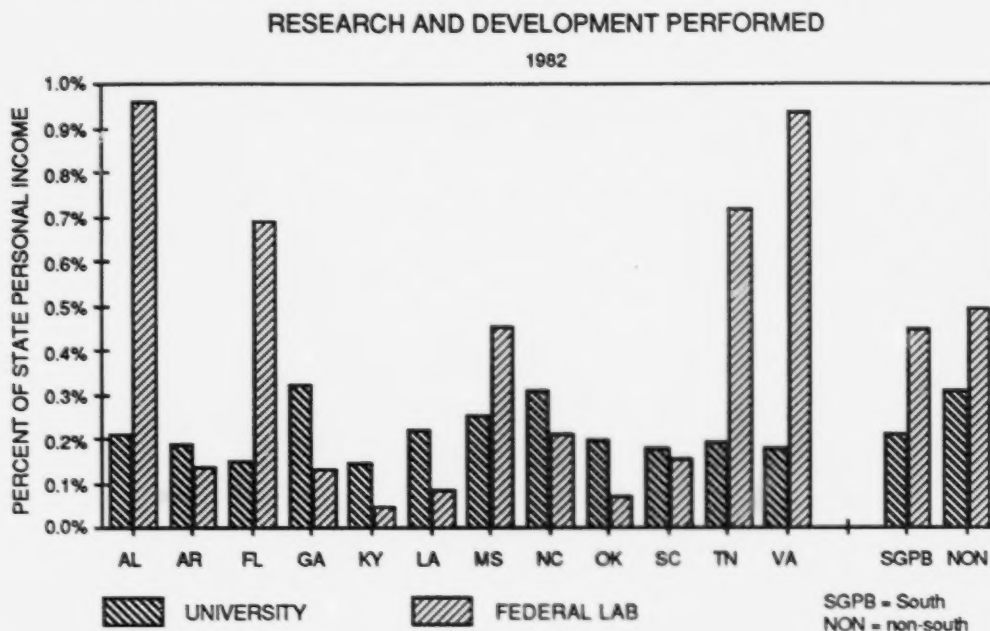


- J. The South trails the nation in support for research and development from the federal government, and trails the nation by an even wider margin in R&D support from industry.

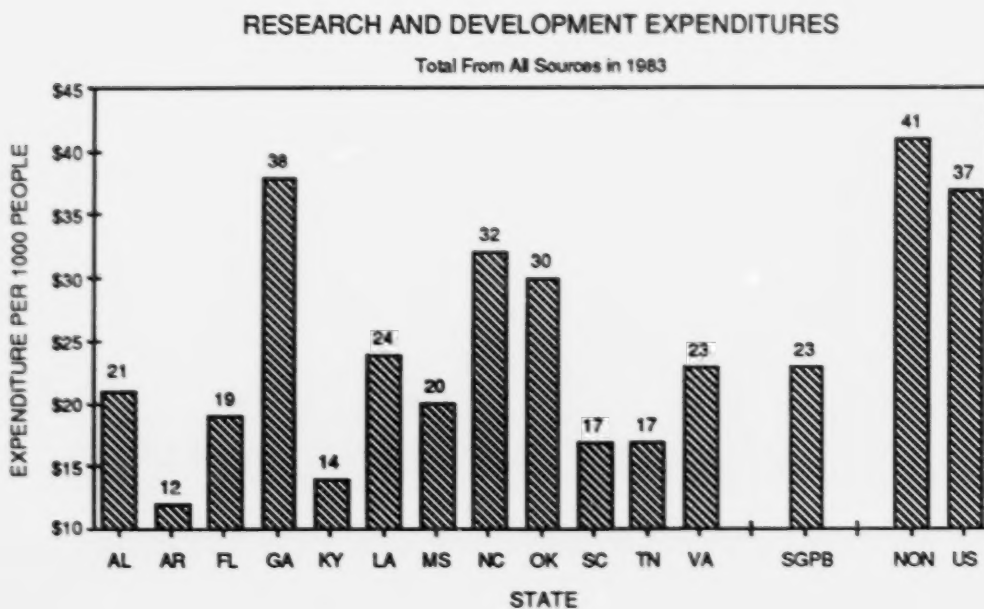
RESEARCH AND DEVELOPMENT SUPPORT (1982)



- K. The dollar value of R&D performed at universities, as a percent of personal income, is lower in the South than in the rest of the nation. Proportionally less R&D is performed at federal research labs in the South than in the rest of the nation.

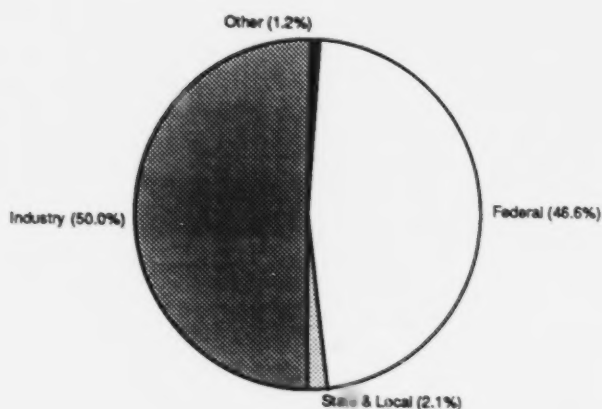


- L. In recent years, R&D expenditures in the South averaged \$23 for every 1,000 Southerners. R&D expenditures outside of the South averaged \$41 for every 1,000 non-Southerners.

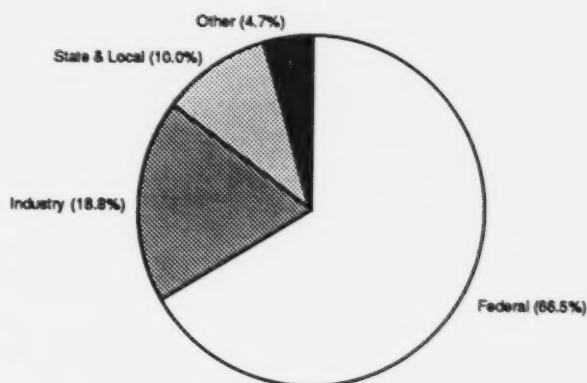


- M. Federal sources account for less than one-half of the total funding for R&D in the U.S., but federal sources account for two-thirds of the funding for basic research. The proportion of federal R&D funding allocated to defense R&D has increased from 50% in 1980 to an estimated 72% in 1986.

FUNDING SOURCES FOR TOTAL R&D
1985 Estimated Funding

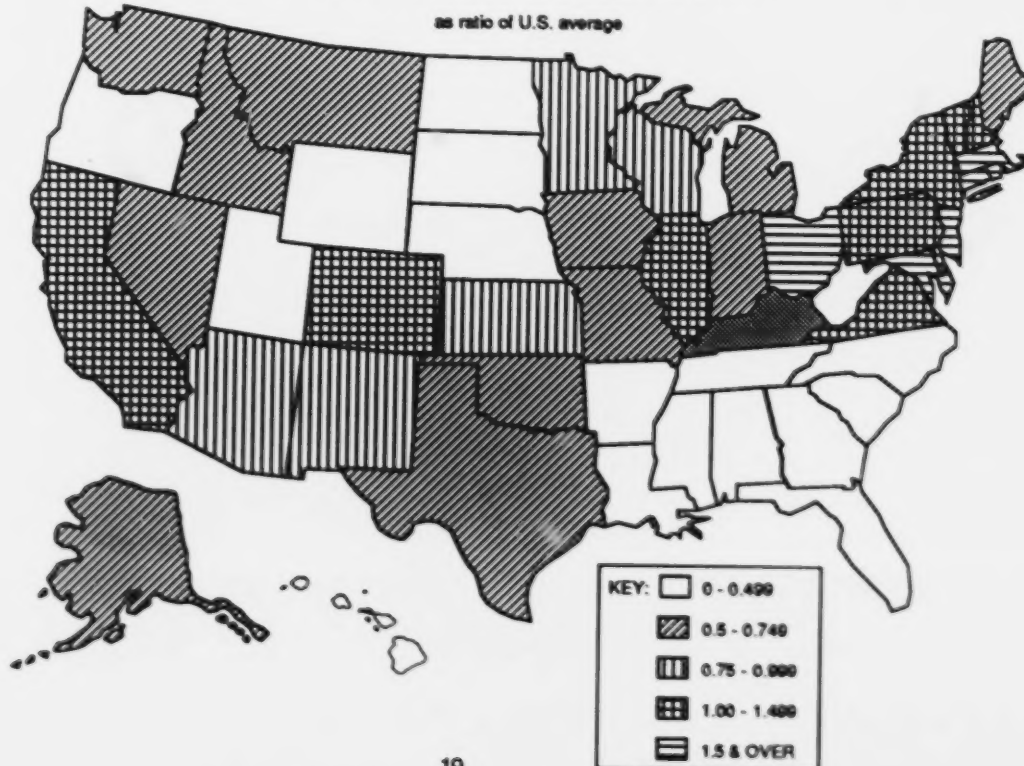


FUNDING SOURCES FOR BASIC RESEARCH
1985 Estimated Funding



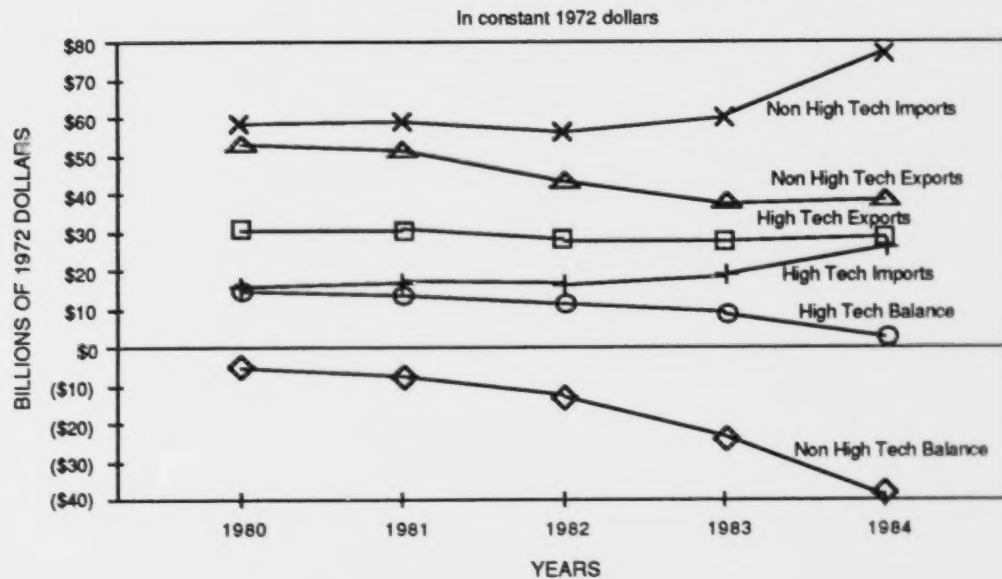
- N. Eleven of the twelve southern states have fewer industrial R&D labs than the national average per capita.

INDUSTRIAL R&D LABS PER CAPITA



- O. The U.S. had a trade deficit in non-high tech products between 1980 and 1984. The U.S. had a trade surplus in high tech products during the same period, but the surplus has been shrinking.

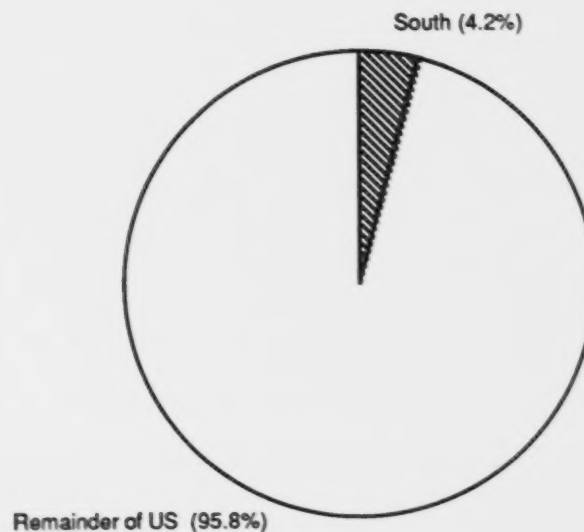
HIGH TECH AND OTHER MANUFACTURING TRADE



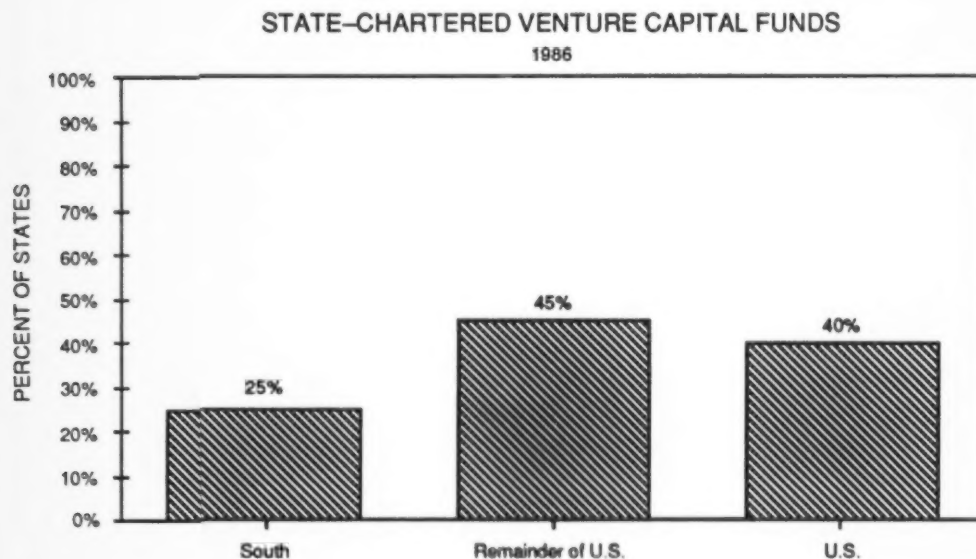
- P. Southern states received less than 5% of the venture capital invested in 1982.

VENTURE CAPITAL RECEIPTS

1982



- Q. Twenty-five percent of the southern states have state-chartered venture capital funds. Forty-five percent of the states outside of the South have such funds.



FINDINGS AND RECOMMENDATIONS

Two forums on technology and innovation, together with a review of recent literature, provided a wealth of information about ways to better harness technology for economic development. Sorting through the information that was amassed led the committee to a number of general findings about the status of technology-related development.

Education and Training

Findings

The importance of education and training was mentioned in committee testimony more frequently than any other single issue; education and training may be the most important elements in promoting high quality development in the South.

An underskilled, unemployed, and poor population is a drag on the economy and the fiscal and service capabilities of the states, detracting from the potential for technological development. The labor force is increasing more rapidly in vulnerable areas and among the least educated and skilled population groups: in rural and already depressed areas, where education and training are least available and effective, where transportation systems are inadequate, and among women, minorities, and the poor. Postsecondary vocational education in the South is not tied well enough to current and projected labor market demands. Increasing numbers of the adult workforce are being displaced by new technology and foreign competition, but retraining programs exist for only a small percentage of them.

There are many dimensions to the issues, however; it is not as simple as raising test scores. It involves (a) preparing youth for a workplace that is being transformed by technology (elementary and secondary education); (b) ensuring that youth and adults have the communications skills that will be necessary in a workplace with more technically sophisticated equipment and management; (c) preparing youth and adults for the new occupational skills that will be needed and the emerg-

ing jobs (vocational education); (d) preparing youth to be able to adapt to change—learning *how* to learn; (e) ensuring an adequate supply of scientists and engineers (higher education); (f) equipping current and future leaders with the tools to manage innovation and change by restructuring business curricula and offering continuing education programs; (g) increasing retraining efforts to match accelerating rates of occupational mobility; and (h) introducing entrepreneurial skills throughout the education system.

A new report from the National Research Council, for example, concludes that work in automated factories requires far greater flexibility, interaction, problem solving, communications skills, and independence than work in traditional labor-intensive factories. The committee testimony substantiated the National Research Council's views. Edward Nelson of Ford Motor Company highlighted the need for more computer literacy, vocational training for technical jobs, and flexible and versatile education for engineers. Dr. Bill Cunningham of the AFL-CIO recommended joint business-labor retraining efforts, and Dr. Daniel Hodge of Virginia Tech suggested removing barriers to faculty entrepreneurship. Tom Mays of NCR, Inc. advocated closer links between industry and educational institutions at all levels, and pointed out the rarity of executives who can adequately manage innovation.

Recommendations

- *Reinforce commitments to education reform* already underway by providing the resources to achieve the outcomes desired. Although SGPB states have increased investments 25 percent more than non-SGPB states in the past three years, at least 25 percent more is needed to implement the improvements underway. Target resources to rural and educationally deficient school systems. Increase programs for dropout prevention, school-to-work transition, and job readiness training. Concentrate on improvement in basic skills, functional competence, analytical skills, communication skills, and entrepreneurship.
- *Expand public television to teach literacy skills.* Many of the functionally illiterate are isolated and/or unwilling to enter a traditional educational setting. Public television represents a cost-effective means to reach adults in the non-threatening setting of the home.
- *Rotate teachers through non-education jobs in industry, government, or non-profit organizations* on a regular basis and without loss of tenure. This would give them experience in the community and in the world of work that most of their students will enter, and improve their effectiveness as teachers. Concurrently, encourage business people to come into schools, instruct students, donate equipment, and assist in curriculum development.
- *Build into the educational philosophy the assumption that individuals are likely to change jobs and careers several times in a lifetime, requiring flexible skills, adaptability, and recurring educational opportunities.* The latter ought to include adult vocational education certificate programs that can be completed in less than a year.
- *Restructure vocational education to allow 11th and 12th grade students, who have demonstrated a prescribed level of basic competencies, to enroll in occupationally specific programs in the community colleges.* Thus, federal funds ought to be allocated to community colleges and technical colleges through a state's postsecondary governing board. Vocational education resources ought to be committed to those programs that provide the skills to match current occupational projections.
- *Invest in Top Scholars programs at outstanding colleges and universities* for promising students in mathematics, science, and technology. Recipients would be required to return to work in the state for a set time period for each year of assistance. States would seek to identify and select qualified women and minorities.
- *Provide a significant infusion of resources to bring engineering research and graduate programs into a strong nationally competitive position.* Particular attention must be addressed to upgrading research equipment and facilities, and provisions for their depreciation and amortization.

Targeting Resources to Create Centers of Excellence

Findings

Since financial and intellectual resources are limited, only a limited number of research centers will be able to become world-renowned Centers of Excellence. As research becomes more of a

collaborative process, and results come to depend on effective exchange of information, the targeting of state funding becomes more important. Therefore states—and the region—must make difficult choices among institutions and areas of specialization and allocate resources accordingly. To successfully attract the best researchers and students, to expand industry involvement, and to attract federal and private R&D dollars, selected programs must be of world-class quality. Non-partisan peer review may be a worthwhile way to allocate resources. As Dr. Phillips of the NSF told the Committee, "In the current climate of financial and human resource limitations, selectivity is required; strength in all areas is not likely to be possible."

The large majority of these Centers will be located in metropolitan areas. Conditions that support and encourage technology and innovation and the economic development that it generates, e.g., transportation hubs, R&D centers, good schools, and telecommunications systems, are more likely to be found in metropolitan settings. Thus, just as R&D is centralized, technology-based development is likely to be more highly centralized than traditional development. As Dr. Malecki told the Committee, high quality urban amenities are an important ingredient in attracting an educated workforce.

Recommendations

- To avoid duplication and create a "critical mass" of world-class expertise, states should *target resources to create Centers of Excellence* based on state or regional comparative technological advantage. Where appropriate, states should pool resources to fund centers. Access to the knowledge produced by the Centers should be made available to researchers and businesses throughout the region.
- Rather than spreading resources among several institutions, individual states should *target research and development dollars in each subject area to a lead institution* within the state best able to meet the state's needs. Lead institutions should be required to form consortia with other institutions in the state.
- To foster competitive excellence and target resources where they are best used, state funding of technological research and development programs should be (a) *market driven*, by requiring a substantial *private sector match for publically invested funds* and (b) *subjected to independent peer review*.
- The Southern Technology Council was recently formed to help manage regional cooperation in research and development efforts and hasten the transfer of worthy innovations. Initial efforts include creating a prototype regional center of excellence. Southern states should *strengthen support for the newly-formed Southern Technology Council*.
- Southern states should cooperate to *develop a regional technological infrastructure*. Initial efforts could be targeted to shared use of a regional supercomputer and the development of an interactive, multi-user telecommunications network.
- States should aggressively pursue the *creation of endowed chairs in science and engineering fields, jointly funded by public and private funds*, in order to attract high quality faculty and to support research in targeted areas with growth potential.

Cooperation Among Employers, Employees, Universities, and Government

Findings

"Partnership" has been so popular in recent years that the concept has become almost trite, yet it may have its greatest usefulness in technology-based development. The links between basic research, applied research, and commercialization bring universities and businesses closer together. Government can strengthen the linkage by selectively providing the resources that cement the relationship. States can play an important role in developing factors which attract emerging industries—good schools, high-quality public services, a clean physical environment, and cultural and recreational amenities.

Technology and innovation are dependent on colleges and universities in a number of ways. First, they depend on the products of the schools, the graduates who conduct the research to develop technological advances. Second, businesses that depend on technology—particularly

those that are small—may require the services of university faculty. Third, the university brings with it cultural activities and continuing education opportunities that are attractive to professional and technical employees. Many states could improve efforts at marketing the strengths of their universities. According to Dr. Malecki's testimony to the committee, "The location pattern of R&D clearly shows that areas with several very good universities with graduate programs are most attractive to both large and small high tech companies and their R&D operations."

Recommendations

- When states provide seed capital, venture capital, or incubator services, they should consider *taking a small equity position in the firms that they assist* in order to reduce subsequent revenue needs.
- States should *better market* the research abilities of their universities and their position as information brokers for a broad spectrum of topics.
- States should *allow businesses to build engineering and research & development centers on or near university campuses*, provided a portion of the space and equipment is made available to university researchers and students. States can better leverage private-sector research and development to provide public benefits.
- States should establish *technology transfer tax credits*, excluding royalty income obtained by the licensing of technology within the region from state taxes.
- *Incentives to encourage professors of science or technology to take brief sabbaticals to work within the private sector* would give academics a better sense of the private sector's needs and enhance the commercialization of products of research and development.

Global Competition and Automation

Findings

As Dr. Max Lennon pointed out, technological development must adjust to a world economy. The South's traditional selling points of low wages, low taxes, and low levels of public services have been usurped by other nations. The South must look to its role in the world economy, not just the national economy. There are a growing number of joint ventures between American and foreign firms, increasing investments by foreign firms locating in the United States, and increased foreign competition for both markets and products. Eighteen European countries are collaborating on R&D through a multinational organization, EUREKA, to capitalize on new technologies. Georgia and China have formed China/Tech to promote joint ventures.

Advances in robotics, flexible manufacturing systems, computer-aided design, and computerized management systems can reduce the costs of manufacturing enough to be competitive. Automated manufacturing, however, requires fewer unskilled and semiskilled and more technical employees, large initial capital investments, and continuing R&D. Spending on automated manufacturing is expected to grow from \$15.4 billion in 1985 to \$32.2 billion in 1990. This will not only alter the way goods are produced, but it will expand opportunities for the producers of automated equipment. If employers and employees are to work together for increased productivity, employee performance rewards may need to be explored.

Recommendations

- Southern states should *cooperatively establish trade offices in selected countries* to assist small and medium sized businesses throughout the South establish export markets and procure foreign supplies.
- States should *support the development of new manufacturing technologies and improved management methods* and *expand industrial extension programs at universities* in support of disseminating information about new manufacturing technologies.
- States should work with small and mid-sized producers to *establish marketing cooperatives* to increase sales to other regions and overseas.

Long-Term Commitment to Competitive Excellence

Findings

The commercial results of technology and innovation require patience. The length of time to achieve measurable results may be beyond typical terms of office. The long range perspective applies to development activities and R&D. Therefore, the criteria by which programs are judged cannot be short-term or politically inspired, such as totaling up the number of jobs created. A longer-term vision of the creation of a "critical mass" of intelligence and innovation is called for. As Dan Dimancescu told the committee, "To be successful, R&D consortia must be viewed as a long-term commitment, part of which involves sustained financial commitments to universities."

If state and local governments are to play a larger role in technological development, they must foster a more dynamic image. Government agencies need to be more flexible and responsive, with clear lines of authority and fewer levels of bureaucracy. According to Roger Vaughan, government must be careful in how it involves itself in the market, and once having entered, it must ensure that its involvement produces benefits. The use of small project teams, extracting equity positions in return for governmental assistance, and including sunset provisions in both assistance to the private sector and the public programs themselves, were among the suggestions offered by such speakers as Trent Williams of Gulf South Research Institute, Walt Plosila of the Pennsylvania Department of Commerce, and Joseph Pentecost of the Advanced Technology Development Center at Georgia Tech.

Recommendations

- Coordination of state policies to foster technological development could be improved by developing a detailed state strategic plan, not only to estimate the costs of economic development initiatives, but also to identify related state activities attractive to technology-based industries: good schools, a clean physical environment, adequate transportation and telecommunications systems, and recreational and cultural amenities. States should involve a broad geographic and economic spectrum of their citizens in developing strategic plans in order to foster realistic and equitable uses of resources and to gain statewide commitment to implementation.
- State and local governments should establish one-stop-shops or clearinghouses for all permits and economic development services required by small businesses. These include, for example, providing comprehensive permit applications with accompanying handbooks and authorizing economic development officials to approve such development measures as public low-interest loans or customized training programs.
- States should be dedicated to long-term commitments to technology programs, but should include sunset provisions in specific projects to ensure periodic review for continued funding.
- Where applicable, state laws could be changed to permit investment of a small portion of public pension funds in approved venture or seed capital companies. General trust laws should be changed to permit "prudent management" to include a limited amount of venture capital investment.

APPENDIX A

LIST OF SPEAKERS AT COMMITTEE HEARINGS

- William S. Bard**, Vice President for Strategic Planning for CCS Automotive Systems in Houston, Texas.
- David S. Bushnell**, Director of the Technology Transfer Study Center at George Mason University in Fairfax, Virginia.
- William Cunningham**, economist with the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO) in Washington DC.
- Dan Dimancescu**, Partner in the Technology and Strategy Group in Cambridge, Massachusetts.
- Walter Y. Ellsha**, Chairman, Chief Executive Officer and a director of Springs Industries, Incorporated in Fort Mill, South Carolina.
- Douglas K. Freeman**, Senior Vice President for Citizens and Southern Corporation in Atlanta, Georgia.
- Thomas E. Gaffney**, Director of the Drug Science Foundation in Charleston, South Carolina, and Professor of Medicine at the Medical University of South Carolina.
- Dan Hodge**, Professor and Head of the Department of Electrical Engineering at Virginia Tech in Blacksburg, Virginia.
- James Holderman**, President of the University of South Carolina in Columbia, South Carolina.
- Timothy L. Hunt**, Senior Research Economist at the W. E. Upjohn Institute for Employment Research in Kalamazoo, Michigan.
- Max Lennon**, President of Clemson University, Clemson, South Carolina.
- Edward J. Malecki**, Associate Professor of Geography at the University of Florida in Gainesville, Florida.
- Thomas Mays**, Director of Engineering for NCR Corporation.
- Eugene M. Nelson**, Executive Director for Manufacturing for Ford Motor Company in Dearborn, Michigan.
- Joseph L. Pentecost**, Acting Director of the Advanced Technology Development Center at Georgia Tech in Atlanta, Georgia.
- Don I. Phillips**, Executive Director of the Government-University-Industry Research Roundtable of the National Academy of Sciences, in Washington, D.C.
- Walter H. Plosila**, Deputy Secretary for Technology and Policy Development for the Pennsylvania Department of Commerce.
- J. Trent Williams**, Vice President for Resource Planning and Management at Gulf South Research Institute in Baton Rouge, Louisiana.

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The Associate Membership Program addresses economic challenges in the South by encouraging a partnership between the public and private sectors. Associate members include corporations, non-profit organizations, and educational institutions.

Dues from the Associate Membership Program go into the Fund for the Future of the South, a permanent source of financial support for the Board. The Fund is used to carry out special projects in economic development and other areas crucial to implementing the recommendations of the 1986 Commission on the Future of the South.

For information about the Board and its work, please write: The Southern Growth Policies Board, P.O. Box 12293, Research Triangle Park, NC 27709. Telephone (919) 549-8167.

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Elaine Kelly
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Vivian Fowler
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1986 Commission on the Future of the South Published Documents

Halfway Home and A Long Way to Go

The Final Report of the 1986 Commission on the Future of the South

The Report of the Committee on Technology and Innovation

The Report of the Committee on Human Resource Development

The Report of the Committee on Government Structure and Fiscal Capacity

Cross-cutting Issue Report No. 1:

**Financing Economic Development in the South:
Public Infrastructure and Entrepreneurship**

Cross-cutting Issue Report No. 2:

Equity: The Critical Link in Southern Economic Development

Cross-cutting Issue Report No. 3:

**Rural Flight/Urban Might:
Economic Development Challenges for the 1990s**

Cross-cutting Issue Report No. 4:

**International Trends and Policy Implications
for Southern Economic Development**

Cross-cutting Issue Report No. 5:

**Education, Environment, and Culture:
The Quality of Life in the South**

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